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PROGRESS REPORT
FOR PERIOD ENDING
15 SEPTEMBER 1954
ON
4 INCH ROCKET

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During August special instrumentation was set up for static testing rocket motors and the first series of tests was carried out.

Static tests of individual rocket motor units are essential to determine the conditions required for ignition and uniform burning of the propellant as well as to ascertain the suitability of the inert materials. In such tests the motor is held fixed in an adapter so that measurements may be made of the pressure developed within the rocket during the firing. Pressure-time records thus obtained furnish the data required for the design of a properly functioning motor.

The first propellant tests were made in a conventional steel motor tube. This tube was threaded externally at the head end to fit an adapter to which a pressure transducer could be attached. The nozzle end was internally threaded to receive inter-changeable test nozzles. The adapter was provided with an insulated, high-pressure-sealed, electrical terminal so that electric squibs could be fired at the head end without nozzle end wiring. The adapter was designed to mount a Baldwin Lima-Hamilton SR-4 strain gage pressure cell. The adapter was mounted in a barricaded space with electrical leads running through one wall to the recording instrument, which had been built for closed bomb powder testing, was adapted to record the rocket pressures.

This instrument automatically produces calibration lines on the photographic record and provides the firing voltage for the rocket igniter. At the same time, the firing voltage is applied, a single X-axis sweep is started on the cathode ray tube and this sweep provides the time base for the pressure record. Signals from the SR-4 pressure cell are pre-amplified by an Allegany Instrument Company Model 205 D.C. amplifier. The output of this amplifier is applied to the Y-axis D.C. amplifier built into the oscillograph. The Y-axis signal is mixed with a time pulse which calibrates the time base. The frequency response of this system is flat from 0 to 3000 psi. The photographic record may be obtained on 4" x 5" oscillograph paper but at present the record is obtained on a Polaroid Land paper by means of a 4" x 5" Graflock adapted Polaroid Land Back. While this cuts down the size of the record to 2-7/8" x 3-13/16", it is very convenient for intermittant testing since photographic processing solutions need not be set up to obtain a record.

The propellant grains used in these tests were JPN powder extruded as 0".60 O.D. cylinders with a single arial cylindrical perforation of 0".27. The propellant as received here 10 September 1954 is in 3 foot lengths. These are cemented into cellulose acetate inhibitor sleeve 0".625 I.D. x 0".750 O.D. by potting a thin layer of polyester resin between the powder and the tubing. In this way the powder is inhibited on its exterior cylindrical surface. After the potted resin is cured the inhibited powder is cut to the desired grain length.

The inhibited grain is supported 0".25 ahead of the nozzle in the motor tube by a spacer ring of the cellulose acetate tubing. The igniter consists of an M1A1 electric squib and a small charge of A-3 black powder. These are contained in a small plastic bag which is placed at the head end of the grain.

In static tests using steel nozzles the pressure time curves exhibited the highly progressive burning to be expected from the grain design. The curves were smooth indicating uniform burning of the propellant without resonance effects or powder break-up.

A second steel motor was constructed to use inter-changeable plastic nozzle inserts. Molded nozzle inserts of polymerized polyester resin were tried first and these eroded too rapidly. The pressure-time curve was regressive in spite of the progressive grain design and in some cases chuffing was encountered near the end of the burning time.

Other plastics and glass fiber reinforced plastics will be tried and it is expected that a sufficiently low erosion rate can be attained.

An apparatus has been designed for static testing a rocket motor with a non-metallic motor tube. Glass reinforced Formica tubes have been obtained and cut to size for the first tests. After an individual motor unit test these tubes will be used in a multiple motor rocket. Test apparatus for the multiple motor unit has also been designed.

PLANS FOR FUTURE WORK:

The future work on this program will proceed as outlined below:

(a) Static firing of single tube motors to establish:

1. Suitable nozzle material and design.
2. Suitable reinforced plastic motor tubes.

(b) Static firing of multiple tube motors to establish:

1. The igniter system.
2. The pressure seals of the multiple tube assembly.
3. The proper pressure-time relation for multiple charges.

(c) Static testing of flight motors:

1. Establishment of safety limits for the operating pressure.
2. Proof tests.

(d) Flight tests for the development of:

1. The flight rocket less delay fuse and bursting charge.
2. The ignition system.
3. The launcher.

Materials and apparatus for carrying out this program are being obtained and no unwarranted delays are anticipated.

FINANCIAL STATEMENT:

Amount of Contract	
Expenditures for August 1954	
Total Expenditures to 31 August 1954	
Unexpended Balance	

50X1